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CYTOSPORA CANKERS ON RED FIRS WITHIN THE SUNDOWN SALE UNIT, ILLINOIS VALLEY RANGER DISTRICT, SISKIYOU NATIONAL FOREST

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ABSTRACT

Red firs on an area near Althouse Mountain, Happy Camp Ranger District, are so heavily infected with dwarf mistletoe and Cytospora canker that timber on a 13-acre unit is now being considered for removal as the Sundown Sale. No action, overstory removal, and clear cutting alternatives are presented. Nearby at Bolan Mountain, an area of young, even-aged red firs was suspected to have a developing problem with Cytospora canker and branch dieback, but only minor infections occur at the stand edge. The areas are administered by the Happy Camp Ranger District, Klamath National Forest, and are in Oregon.

INTRODUCTION

During the afternoon of August 26, 1981, I accompained Bill Jones and Jim Kilgore of the Happy Camp Ranger District to the Sundown Sale Unit at the head of Green Creek near Althouse Mountain. The location is in Oregon within that portion of the Siskiyou National Forest administered by the Happy Camp District of the Klamath National Forest. The unit is located downslope from the access road. The land upslope from the road is administrated by the Illinois Valley Ranger District, Siskiyou National Forest.

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OBSERVATIONS

The Sundown Unit consists of approximately 13 acres of red and white firs located within a bowl-shaped relief swept by prevailing westerly winds. Red firs that are about 250 years of age dominate the stand. A second canopy level consists of small-sawtimber red fir and some white fir of about 100 years of age. The clustered understory consists of red and white firs 5 to 15 ft. in height.

The red firs in all three stories are infected with dwarf mistletoe. Few of the overstory red firs would rate less than 5 or 6 on the Hawksworth rating scale for dwarf mistletoe intensity. Witches' brooms are abundant and the crowns of most of these veterans also contain many Cytospora canker infections, most of which are associated with the dwarf mistletoe infections. (For reasons not fully known, Cytospora canker and dieback are more common on branches invaded by dwarf mistletoe.) The death of branches from the infections, along with the effects of wind and ice and snow, have resulted in the loss of much foliage and many tops. Height growth has all but ceased on most of these firs and the 100 year-old firs are beginning to reach into the canopy level of the older trees. Amount, density and color of the foliage as well as the apparent overall vigor of the overstory firs indicate that 25 to 40% will die within 5 to 7 years.

The red firs of 100 years of age can be divided into two classes. In the minority are those firs that already show large numbers of dwarf mistletoe and Cytospora infections. The crowns are beginning to lose branches and often have a "thin" appearance. The majority of the younger firs have a conical crown form, acceptable height growth and few Cytospora cankers are apparent. However, observations with 10 x 50 power binoculars proved that numerous dwarf mistletoe plants were present even though brooming and associated Cytospora infections were not. Many of the dwarf mistletoe plants were in the upper-third of the crown and it is unlikely that these tall trees could have sufficient growth under any future management regimen to outgrow the influence of the dwarf mistletoe infections. Additionally, with the present heavy Cytospora infection in this and surrounding areas, it is unlikely that these trees will continue much longer without serious Cytospora infections.

Unfortunately, many of the understory red fir of 5 to 15 ft. were already infected by dwarf mistletoe. Some of these trees might be able to outgrow the infections if released. However, small suppressed trees infected in the bole often die above the point of infection. The result is deformed trees and commonly the death of the tree. The understory trees tend to occur in pockets and by themselves would not provide sufficient or uniform stocking if the overstory was removed.

The white fir in the understory and in the 100-year class were not infected with dwarf mistletoe and were not seriously affected by Cytospora.

Fir engravers, Scolytus spp., did not appear to be particularly active in the stand for there was no tree mortality or pitch streaming as a result of attacks. Attacks on declining branches are suspected, but could not be verified without felling one or more trees.

THE PEST ORGANISMS

Cytospora Canker

Cytospora abietis is a damaging fungus that commonly causes cankers on true firs throughout their natural range in California. The most notable symptom of infection is flagging of branches, or death of tops and small trees. Flags begin to appear in late spring and in early summer. They are initially brick red, but turn light brown by autumn. Much of the dead foliage remains on flagged branches for at least a year and sometimes 2 to 3 years.

The extensive, numerous Cytospora infections in this stand and surrounding areas indicate that environmental conditions are very suitable for continued damage. The trees, red firs in particular, suffer from several environmental stresses that can increase the likelihood of infection by Cytospora abietis. The western aspect and contour of the site subject the trees to the impact of the winds of storms coming in from the Pacific. Ice and snow would compound the effect. Dwarf mistletoe is abundant on the red fir and is the most important factor adversely affecting the vigor of the trees. Precipitation levels at the site probably followed the general trend in northern California in 1981 in being well below normal. Other stressing factors that can predispose firs to Cytospora infections are fire injury, logging wounds, poor site, root damage or disease, soil compaction, sudden exposure to light, and patch killing of bark by twig or bark beetles.

True Fir Dwarf Mistletoe

Two forms of dwarf mistletoe occur on firs. Each is host specific. The larger number of dwarf mistletoe plants and Cytospora infections in the red fir indicate that Arceuthobium abietinum f. sp. magificae is abundant in the stand. The absence of observeable plants and the small amount of Cytospora flagging in the white fir indicate that A. abietinum f. sp. concoloris is infrequent or absent from the stand.

Dwarf mistletoe swellings provide openings in the host bark for invasion by the fungus Cytospora abietis, and a favorable environment for growth and development of the fungus. In California, about 20% of the fir branches infected with dwarf mistletoe are invaded and eventually killed by Cytospora. As a result, the fungus exerts some biological control of dwarf mistletoe. But the reduction of a significant proportion of the living crown from branch dieback probably has a more adverse influence on tree growth than a favorable influence in reducing the amount of dwarf mistletoe.

Dwarf mistletoe seeds are explosively discharged from the fruit. The lateral distance that discharged seeds may travel is usually given by the rule of thumb: maximum distance potential is equal to the height of the infection (plant) above the ground. The sticky seeds adhere to any surface they strike during their flight. Naturally, needles are the primary receptors. During fall and winter rains the seeds swell and become slippery. Some slide down the foliage to the twigs and others slip from the foliage to fall to lower branches or the ground. Those seeds on twigs less than two years old are in position to germinate in the spring, and by the growth of a radical and "holdfast" tissue, to initiate new infections. Fortunately, because of the long life cycle of dwarf mistletoes, this means of spread is not rapid. Lateral spread of the parasite in an even-aged stand is probably somewhat less than 1 to 2 feet per year while the vertical spread within the crown averages only 3 inches per year. Dense, persistent nearby fir foliage often traps the seeds before they disperse any great distance. However, after the crowns begin to break up because of Cytospora dieback, dense foliage would be less of a factor and the rate of spread could increase.

DISCUSSION

Cytospora canker within and adjacent to the Sundown Sale Unit is extensive and severe. This abundance is facilitated by numerous dwarf mistletoe infections and apparently by climatic conditions that favor spread and infection of the fungus. Management alternatives for reducing dieback and creating a healthy stand can do little about climatic conditons and are best directed at reducing the abundance of dwarf mistletoe and other factors that produce wounds in living branch tissue.

Management Alternatives

1. Do Nothing. If the stand is left to the present condition, the health and vigor of the trees will continue to decline. The dwarf mistletoe in the overstory red firs will continue as a source of infection for the 100-year-old trees and the understory; and additional dwarf mistletoe infections, and subsequent Cytospora infections, will further drain tree and stand vigor. The crowns of overstory trees will continue to break up and decline, with the result that other mortality factors such as bark beetles are apt to become more significant in the stand. However, veteran red firs can be expected to dominate the site for several decades to come before they are replaced.

Total live stand volume should decrease as the large-volume red firs die and the heavily infected 100-year class and understory are unable to sufficiently respond to maintain productivity over time. In other words, the younger firs are likely to succumb to various mortality causes before they reach the size, age and abundance of the present overstory. They in turn will be the source of infections for any reproduction coming in under them. The cycle will go on indefinitely unless interrupted, and the manager will be unable to capture the potential productivity of the site.

The extent of future natural reproduction cannot be anticipated because the influence of heavy dwarf mistletoe and Cytospora infections on cone production is unknown. The present limited cone production capacity of the overstory, as shown by the number of branches bearing cones in 1981, indicates that production would be less than normal over the life expectancy of the of the younger firs. The production of "stress crops" is always possible, but this usually occurs by individual trees and as such is an unreliable seed source. Of course, only one good seed year combined with desired soil and climatic conditions could produce the regeneration desired. But, it is difficult to foresee this combination occurring without some form of entry into the stand prior to seed fall.

2. Overstory Removal. Several of the 250-year-old red fir are currently dying. All are overmature, no longer growing rapidly, probably losing net volume through heart rots, providing dwarf mistletoe innoculum for infection of the 100-year-old red firs and understory, and losing significant portions of their crowns to dieback and the effects of the elements. Removal of these dominants would lessen the competition on the 100-year class, and thereby increase their vigor and growth. Removal also would greatly reduce the sources of further infections in the stand. Unfortunately, most of the anticipated leave trees already have incurred numerous infections if they are red firs, and the infection cycle would remain unbroken and the site potential unattained. If sufficient white fir exists among the 100-year-old trees to provide adequate stocking, then the more severely infected red firs of all sizes could be removed. This would provide good prospects for a future stand predominantly of white fir and relatively free of the present dwarf mistletoe/cytospora problem. Care should be taken during logging for a residual stand is often seriously affected by Cytospora because of logging injury and exposure shock.

3. Selection. The small size of the unit and the severity of the dwarf mistletoe/Cytospora infection throughout the area in all size classes preclude the use of this silvicultural practice.

4. Clear Cut and:

a) plant with a mixture of red and white fir. Clear cutting would remove the decadent overstory and future sources of innoculum. The mix of red and white firs would duplicate what is presently on the site and would hedge against the failure of one species to survive and occupy the site. Those areas around the unit that are infected with dwarf mistletoe would have to be sanitized to prevent infection of the seedlings. The width of the sanitized border around the unit should be at least equal to the height of the highest dwarf mistletoe plant on trees adjacent to the border. The cooperation of the Illinois Valley District would be required because the uphill side of the unit is adjacent to this District. The road marking the boundary is an ineffective barrier for the downslope spread of dwarf mistletoe because the height of the infections in combination with the steepness of the slope lengthens the effective distance of spread downslope. Strong upslope winds would shorten the distance of spread and winds blowing toward the unit would lengthen the distance leeward.

The unit and surrounding areas are so heavily infected that it may be impossible to sanitize a border without removing all the red fir within the border. This might leave several acres out of production if not planted to white fir. Movement of innoclum back into the unit would have to wait for natural regeneration of red fir within the border to reach 4-6 feet in height, and once this has occurred, movement can be expected at the rate of less than two lateral feet per year. Infections usually move primarily through the lower branches in young trees and would take several years to reach the unit. By this time the planted red firs in the unit should be larger than the natural border regeneration because of their head start and the suppressive effect of the infections. Growth of the unit red firs could then be expected to stay well ahead of the limited (approximately 3"/yr.) vertical movement of the dwarf mistletoe infections once they are reestablished. Firs often outgrow infections in the lower crown because of the natural death of lower limbs and the slow vertical spread of infections. Any red firs within the unit that did become more than lightly infected could be expected to be suppressed by the uninfected white fir. This would check the potential of these red firs for spreading dwarf mistletoe.

The use of a third species adaptable to the site would further diversify the species on the site. This diversity would make it more difficult for any one insect and/or disease complex to affect the future stand to the extent of the present severe infections.

b) plant white fir as a border and red fir or a mixture in the interior of the unit. The white fir in the area appear healthy, have little branch dieback, and dwarf mistletoe plants were not seen within their crowns. Therefore, it would be possible to plant a border of white fir in the unit to act as a barrier against the spread of the dwarf mistletoe of red fir back into the unit. This border should be at least as wide as the height above ground of the highest bordering red fir dwarf mistletoe plant, preferably somewhat wider. Such a barrier should be sufficent to prevent any major reentry of dwarf mistletoe into the interior of the unit. Adjacent areas of infected timber probably will be removed eventually after the establishment of a new stand in the Sundown Unit. The border barrier of white fir certainly would be effective in the meantime. Any red firs becoming established within the barrier and subsequently infected with dwarf mistletoe would become suppressed by the competing uninfected white fire.

c) plant only white fir within the Sundown Unit. Presently no problem exists with the white fir in the sale area. Therefore, clear cutting this small unit and planting white fir would evade the present problem of dieback in the red fir. Chances of planting failure may be increased by decreasing species diversity in the planting stock, but this is a decision to be made by on-site management.

This and subsequent removals could be laid out such that units planted to white fir could act as barriers against infection of units planted to red fir. A mosaic within which Cytospora canker and dieback have been satisfactorily suppressed should be formed. Units with borders of white fir could be used the same way.

Several alternatives exist for replacing this stand severely infected with dwarf mistletoe and Cytospora canker with one relatively free of these problems. Should management decide on one of these, the cooperation of the Illinois Valley Ranger District should be sought and the two districts should work closely together to manage the general area as a whole. Dwarf mistletoe and Cytospora abietis do not recognize administrative boundaries.

Bolan Mountain

One additional stand was observed on August 26. This stand consisted of young red firs that had come up through an old brush field located in T. 41 S., R. 6 W., Secs. 7 and 8. Light to moderate dwarf mistletoe and Cytospora infections were apparent at the edge of the stand along the access road and it was feared that infection of similar intensity occurred within this dense, even-aged stand. Examination of the stand interior proved that this was not the case. Furthermore, spread into the stand from the roadside direction will be slow because the density of the stand will cause a short discharge distance for dwarf mistletoe seeds and the number of innoculm sources is small. However, this stand is heavily stocked and competition stress from overstocking could weaken the trees and provide the opportunity for Cytospora infections within the stand interior. Thinning would improve the vigor of the leave trees and reduce the risk of infection.

The edge infections of dwarf mistletoe apparently came from the stand below the road and this source cannot contribute any further penetration into the upslope stand because of the distance between the two groups of trees. However, the infections along the road could be intensified by further dwarf mistletoe infections from seeds coming from trees below the road.

The stand below the road was unevenaged and Cytospora dieback appeared to be confined to lower branches except in the larger red firs, which were much smaller than those in the Sundown Unit. Among these firs there were scattered individuals with only 20% of their crowns remaining intact. Infections were usually most intense around stand openings, but the overall effect was minor when compared with the Sundown Unit and surrounding areas. Should Cytospora dieback intensify in this stand, then the alternatives listed for the Sundown Unit would apply.

The composition of this stand is better suited to a selection cut than the Sundown Unit. If this approach is taken, then the following types of trees would be the best candidates for removal upon the initial entry.

1) Trees with more than 1/3 of the top recently killed by fir engravers.

2) Trees with Cytospora branch flagging and dieback so extensive that less than 30% of the live crown remains.

3) Trees with open and decayed bole cankers.

4) Trees with a Hawksworth dwarf mistletoe rating of 5 or 6.

Selection of leave trees might be a better procedure than selection of trees to cut.